Secondary School Science Teachers' Knowledge, Responses, and Abilities to Create Inclusive Science Practices in General Education Classrooms in Banjarnegara Regency, Indonesia

Iva Nandya ATIKA[1, 2]
[1] Graduate Student
Graduate School for International Development and Cooperation, Hiroshima University
1-5-1 Kagamiyama, Higashi-Hiroshima 739-8529, Japan
[2] Present address: Senior High School 1 Sigaluh, Banjarnegara
Jl. Raya Sigaluh Km. 13 Banjarnegara 53481, Central Java, Indonesia
atika.ivanandya@gmail.com

Norimune KAWAI
Professor
Department of Special Needs Education, Graduate School of Education,
Hiroshima University, Japan

Abstract

Science teachers in general education settings must be ready for the diversity among the students in their science classrooms; nevertheless, science teachers are not yet prepared to handle students with special educational needs. This study used a qualitative method which purposed to explore teachers' knowledge, responses, and abilities to create inclusive science practices in general education classrooms. Semi-structured interviews contained open-ended questions were conducted to gain the data from nine science teachers including integrated science, physics, biology, and chemistry teachers in Banjarnegara Regency. The participants had to answer all of the questions about the teaching-learning process related to science lessons based on their knowledge and experiences. Data obtained from interviews were analyzed using phenomenology approach with emergent themes from different data sources. The results suggested the secondary school science teachers who participated in interviews conceptualized inclusion only in term of disability, rather than from a position of promoting education for diversity. Besides, the science teachers' responses toward teaching students who faced barriers to learning and participating in science classrooms were predominantly positive, and they made an effort to support the creation and evolution of an inclusive culture and inclusive science practices for diverse students through group work and peer tutoring approaches. The teachers also can demonstrate their skills and abilities to face the challenges that exist in science learning.
Key words: secondary school science teachers, inclusive science practices, general education.

1. Introduction

The United Nations has outlined several sustainable development goals in all aspects of life. One of the most important SDGs, related to education is the fourth goal to promote equitable and quality education for all children around the world including those with Special Educational Needs (SEN) in schools (Osborn, Cutter, & Ullah, 2015). Science classes are ideal in inclusion for all students to offer them the same opportunities to develop their scientific knowledge which is much related to their lives. Moreover, science classes in inclusion environment were mentioned to be ideal because it can provide real experiences for all students, especially when they are studying in groups with the other peers (McCann & Sherman, 1998).

Besides, based on the findings in the preliminary study in Banjarnegara Regency, found that there were SEN students who excel in science subjects after receiving additional attention from the science teacher in the general education school. The science teachers in their classrooms also found difficulties to handle diverse students with different capabilities to build inclusive science practices. Moreover, inclusive science practices for diverse students certainly provides challenges for science teachers to handle and encourage diverse students to be active in science learning. Science teachers as educators need to have special skills to prepare

for learning in their classrooms that meet diverse students' needs to maximize their potential (Stefanich et al., 2001). Therefore, science teachers must have sufficient knowledge toward diversity among students, especially if they meet SEN students in science classes; so that they can design the appropriate method in learning.

Implementation of inclusive education required general teachers to have special strategies in providing learning for diverse students. Recognizing the different needs and abilities of students in general classrooms require teachers' abilities to provide meaningful learning for diverse students to create inclusive practices. Teachers in public schools are often faced with physically and academically diverse groups of students in their classes so that the teachers need to have the abilities to create inclusive practices in regular classrooms. Praptiningrum (2010) suggested that teachers were supposed to have knowledge on students' development and concepts to implement inclusive practices for students with diverse learning needs.

Teachers' understandings of the importance of encouraging students' appreciation can increase their willingness to educate diverse students. Teachers also should have an understanding of the Convention on Human Rights, such as the International Covenant on Economic, Social and Culture Rights, the International Covenant on Civil and Political Rights, the International Convention on the Elimination of All Forms of Racial Discrimination, the Convention on the Elimination of All forms of Discrimination against Women, and the Convention on the Rights of Child and its implications to implement education for all students. Teachers' abilities are essential in creating a learning-friendly environment related to contents, social relationships, approaches, learning materials, adaptive evaluation, and assessment of diverse students including those who have special educational needs. With these capabilities, regular teachers are expected that they can assist students with SEN in accordance with their needs. Therefore, this study aims to explore the knowledge, responses, and abilities of secondary school science teachers to create inclusive science practices in general education classrooms.

2. Methods

To gain a deep understanding of the knowledge, responses, and abilities of secondary school science teachers so as to create inclusive science practices for diverse students in regular classrooms in a general education setting, this study employed a qualitative research design. An exploratory qualitative design following a phenomenological approach was adopted in this study. Phenomenology shows that real events experienced by humans in their lives as a basis of information (Dahlberg, Drew, & Nystrom, 2001; Van der Mescht, 2004). In addition, the phenomenology directly related to someone' experiences about certain things in their lives; how they feel and represent of the phenomenon (Titchen & Hobson, 2005).

2.1 Participants

A total of nine science teachers (two integrated science teachers (IPA), three physics teachers, two chemistry teachers, and two biology teachers) from different schools were selected to participate in this study based on their years of teaching experiences: 2 teachers had less than 10 years' experience, 2 teachers with 10-20 years' experience, and 5 teachers with 20 or more years' experience. To paint a fuller picture of participants involved in this study, their background profiles are summarized in Table 1. The following information cannot show their identities because there are many teachers at different schools in the Banjarnegara Regency who have the same or similar background profiles. Hence, this information does not threaten the anonymity of the study.

Table 1. Background Profiles of the Participants

Participants Code	Teaching Experience	Personal Experience with SEN students
T1	8 years	Yes (minimal)
T2	27 years	Never
T3	30 years	Never
T4	9 years	Never
T5	22 years	Never
T6	18 years	Never
T7	17 years	Never
T8	27 years	Never
T9	27 years	Yes (considerable)

2.2 Instruments

A semi-structured format containing open-ended questions wasused to definethe focus in advance and intend to gain understanding of specific topics. A semi-structured interview allows the researcher to ask a pre-defined chain of questions and obtain more information about the important themes through probes (Gall, Gall, & Borg, 2007). Besides the reasonable control over the process, the flexibility of semi-structured interviews makes it possible to depart from the guide and ask new questions that emerge from the interviewees' replies and to modify not only the order but also the wording of the questions (Bryman, 2004).

The interviews were intended to figure out the participants' perspectives on the prospects of inclusive practices in science learning for diverse students. To gather the information about common and specific topics from the teachers, the main questions of the interview guide were oriented three themes related secondary school science teachers' knowledge of teaching diverse students as part of the inclusive education concept, secondary school science teachers' responses to teaching students who faced barriers to learning and participating in science classrooms, and secondary school science teachers' abilities to create an inclusive culture and inclusive science practices for diverse students as part the implementation of the inclusive education in regular classrooms. Part of the content of the questions is shown in Table 2.

The interview guideline was discussed with the study supervisor to strengthen the items and see if the questions would guide the author to measure what is supposed to be measured. Then, the interview guideline was translated to Indonesian and pilot tested on a science teacher to seek objective opinions on how questions could be made easier to understand and avoid bias or any potential ambiguity. As the results, some words and questions were simplified and some were removed.

Table 2. Themes and Sample Questions of Interview Guide

Themes	Sample Questions
Secondary school science teachers' conceptualization the terminology "inclusive education" in general education classrooms.	1. Have you ever heard about the term of inclusive education? 2. What does the term inclusive education mean to you? 3. What kind of children do you think should be included in an inclusive classroom? And why?
Secondary school science teachers' responses toward teaching students who face barriers to learning and participating in science classes.	1. Do you have any student who faces barriers to learn and participate in science lessons in the classroom where you are teaching? What barriers does/do your students face? 2. Do you think those students who face barriers to learning and participating in science lessons should be taught in inclusive classroom or in a separate classroom? Why? 3. What were the main challenges to teach science lesson for diverse needs of students?
Secondary school science teachers' implementation of inclusive science practices in general education classrooms.	1. How do you create inclusive community in your science classrooms in which students can seek and offer help to each other? 2. How do you create classroom environment which is secure, accepting and value all types of learners equally? 3. What type of adaptations did your student necessitate during the science learning?

2.3 Procedures

Interview data were obtained from nine teachers. The participants were informed the purpose of the study, the procedures for the interview and asked to sign a consent forms. The participants were assured of confidentiality and anonymity. The information was collected personally from every participant, and used only for research purposes. With the participants' permission all the interviews were audio taped. Besides the audio recordings, some reflective written notes were made to memorize all of the important aspects of the interviews that could not be reconstructed through audio records alone. The interviews took 30 to 50 minutes for each participant. Some prompts were used during the interviews when the respondents did not spontaneously cover important topics and aspects defined in advance.

2.4 Data Analysis

The audio materials were listened to several times and converted into the typed text and saved each interview in separate files. The recorded interviews were transcribed verbatim in the original language (Indonesian). With the help of language experts,

the transcriptions were translated from Indonesian to English. After the transcription and translation of the findings were completed, the interview responses were coded with T1-T9. The textual material was analyzed thematically (Braun & Clarke, 2006). Thematic involve a process of classifying findings into themes to find similar topics and organize them into categories.

Multiple readings of the transcripts to ensure the consistency of the study results were conducted to determine the main themes of the data. After numerous careful readings of the transcripts, the data were coded by highlight key themes through manual coding. The aim of such coding is to make sense of the data, divide it into segments, and assign labels to the segments, so as to examine overlapping codes and unite codes into broad themes (Creswell, 2012). The next step involved searching for meaningful sections to grasp the themes related to the research questions. The themes reviewed to see if they had enough evidence and reflecting on how the themes emerged from the data related to particular pre-defined themes. The next was defining and naming themes and categories.

The overall content of the themes and categories contained in the data was defined and is shown in Table 3. The last step was producing a report and relating the findings to theories in other studies to describe the essential meaning of the participants' lived experiences. As the main themes were predefined based on the theory and the categories were derived from the interview data, the analysis can be considered as both deductive and inductive.

Table 3. Themes and Categories of Qualitative Data from Interviews

Themes	Categories
Secondary school science teachers' conceptualization the terminology "inclusive education" in general education classrooms.	Teachers' prior knowledge toward the meaning of inclusive education; students who should be included in an inclusive classroom; and teachers' opinions on inclusive practices in regular classrooms.
Secondary school science teachers' responses toward teaching students who face barriers to learning and participating in science classrooms.	Teachers' responses toward students with physical barriers; students who faced difficulties in science classrooms; and students who have low motivation and other related problems.
Secondary school science teachers' implementation of inclusive science practices in general education classrooms.	Teachers' ability to create inclusive cultures and evolve inclusive science practices that encourage full learning and participation by diverse students; teachers' challenges to create inclusive science practices; and Teachers' adaptation and strategies in science learning for diverse students.

The responses of each participant were verified and presented in relation to the research questions. The transcripts of interviews sections were showed to the respondents to see if the recorded information matched with the participants intention or not. This also was one of the means used to ensure the reliability of the findings. In presenting the research findings, the statements by the respondent were displayed using direct quotations to maintain a sense of the original information (Cohen, Manion, & Marrison, 2007).

3. Results

3.1 Secondary school science teachers' conceptualization the terminology "inclusive education" in general education classrooms

The science teachers' answers in this study showed that they have different prior concepts about inclusive. On responding to the question about the meaning of inclusive education, three out of nine teachers claimed that inclusive education is not a new term, but they did not know what it means.

> *About inclusive school, I just have heard the term, but what it really looks like and how to implement it, I do not know yet. The inclusive school is a special school, for people who are special or for those who have disabilities. (T3)*

T4 and T5 showed a similar opinion as T3's response that inclusive refers to special education, it was indicated that they were not sufficiently knowledgeable about the meaning of inclusion. The term inclusive was not a new term for them, but based on their understanding inclusive education refers to special education which specificity for those with disabilities.

The other six secondary school science teachers' answers showed that they already know about the term of inclusive education, which is intended for all students including those with physical or other disabilities to learn together in the regular school environment with other normal peers. One of six teachers who claimed that she has known about the term inclusive

education explained that students with special needs could be handled with appropriate treatment without being included in a special school.

> *Inclusive education is education for some children with disabilities, so within the class, there should be some treatment that must be applied so that children at least can participate in learning activities without being included in the special school. (T7)*

T6 has an opinion related to the question that inclusive education means education that provides specialized treatment for students according to their needs.

> *Education for students who are in certain circumstances, have different situations than general students, so they need more attention and special handling in the class. (T6)*

After being confirmed to both teachers, the two answers indicated that inclusive education refers to a regular school that includes students who face barriers to learning and participate in the classroom, so there must be special treatment in learning as well. The science teachers' answers in this study showed that they conceptualized inclusion only in term of disability, rather than from a position of promoting education for diversity.

Each teacher defines based on his or her perspective relating types of students who should be included in an inclusive classroom and the answers can be categorized into two groups. A group of teachers assumed that inclusive refers to special education that receives children who have disabilities.

> *Inclusive schools are for students with special needs. For example students with hearing and speech impairment, if those students are included in a regular school, it will be difficult so that they can attend an inclusive school or special school (T3, T5 and T4).*

Findings from the other group of science teachers claimed that inclusive could be aimed to all students, as long as their cognitive aspect supports learning activities in the classroom.

> *Students who have normal cognitive and they can follow the learning process with other students. However, if the students have a visual impairment, it will be difficult. For students who are deaf or have physical disabilities can still be included in a regular classroom. (T1, T8, T6, and T9)*

Based on teachers' answers, teachers who did not know the full meaning of inclusive education tend to associate inclusive education with special schools. Then the other teachers argued that all students might enter the inclusive classroom with equal or similar cognitive abilities to other normal students in the school. It indicated the teachers' agree that students with special needs who typically learn in special schools may continue to regular schools or inclusive schools as long as their cognitive abilities qualified.

3.2 Secondary school science teachers' responses toward teaching students who have barriers to learning and participating in science classrooms

During the analysis, three categories emerged from the teachers' responses of their reactions toward teaching diverse students including students with physical barriers, students who face difficulties in science classrooms, and students who have less motivation and other related problems.

Two of nine secondary school science teachers claimed that they had encountered students with SEN regarding with physical limitation in their science lesson. The teachers have experienced to teach blind, deaf and physically disabilities students in different academic years. Both teachers work in different schools and have different experiences in teaching time to handle students with disabilities. The teachers showed different experiences in dealing with a blind student that influenced by some factors related to student's conditions, supportive learning media and support from other experts. One teacher performed a negative feeling toward a blind student and claimed that the school did not have appropriate learning media such as braille books to accommodate the blind student as well as special supports from related parties.

> *For the blind student, there must be an assistant. His parents cooperate with blind student's friend in the same class to assist his activities during school time as well as in classroom learning. I have to be patient. It would be better if all students were normal. If the inclusion includes blind students, there will be bothered. They lack a visual sense and [find it] difficult to obtain science materials. (T1)*
>
> *We lack services related to adaptive learning media for a blind student. We don't have braille books. The condition makes*

teachers face challenges in teaching a blind student. And I feel difficult to explain orally, because the student cannot imagine it. We also do not receive special support from government or other related parties. Therefore, we lack knowledge and abilities to teach the typical students. (T1)

Besides, the other one exhibited a positive impression to a blind student in science classrooms. The teacher also had consulted with a special teacher to obtain additional knowledge related to ways in handling students with SEN.

I had taught a blind student. She was a smart student, she could excel in all subject, especially in mathematics and science. So, there was no problem in teaching science materials to her. I have to slightly modify my teaching practices to the blind student because there are still limited braille books and other assistive technology. (T9)
I have received support from special school teachers in this regency. The special teacher helps us in dealing with students with SEN according to their limitation. For example, the ways to teach a blind student that maximizes hearing and touch senses. Once a week, a special school teacher comes to this school and helps the student to use braille equipment in learning. (T9)

The other science teachers stated that the difficulties experienced by students were related to mastery of science contents and those who have low motivation to learn science.

Related to inclusive, there is no student with disabilities here. Students face specifically difficulties in physics materials can be said there are about 50% of students face difficulties in each class. For example, they difficult to understand physics concepts, to memorize the formulas and also to apply physics concepts. (T5 and T3)
There are no students with physical limitation here. All students are normal, but some of them lack concentration because of different family background condition. […] Students who need special attention are still existed, not in term of intelligence but in terms of less motivation. (T6, T7 and T8)

3.3 Secondary school science teachers' ability to create an inclusive culture and inclusive science practices for diverse students in regular classrooms

Teachers in this study showed different answers related to their ability, challenges, and adaptations to create inclusive cultures for diverse students in science learning. Most cases teachers used whole class approach methods involving all students and considering individual learners needs. On answering the question related to how the science teachers create inclusive community in science classrooms to accept and value all students, all science teachers in the current study use peer tutoring and group learning methods with different students' abilities.

In my science class, I create peer tutors, which consist of one student who 'most' masters science materials. If I use the grouping system to do peer tutor, students will be more precise to ask questions and explain the answers to their friends. Students will feel more free and comfortable to ask with their peers. (T4)
With the diversity of students, the learning process places more emphasis on the students' abilities. By knowing students with the abilities they have, in particular case the students that we pointed to help other friends, for example, he/she has abilities in science subjects. Or by forming groups in the science class, so students can discuss and communicate together to create mutual support and understanding the diversity among them. (T5)

The secondary school science teachers answered in different ways about the challenges they faced to handle students' diversity in science classrooms. They also tried to solve the challenges by various ways. The challenges and strategies in inclusive science practices for diverse students based on teachers' experiences are presented in the following points.

3.3.1 Giving students a positive outlook in science lessons

Science teachers assumed that their students felt difficulties when facing science lessons, especially in physics and chemistry subjects the subjects consist of abstract concepts and contain many formulas.

Physics is generally a subject that students feared. So, we should be able to bring physics contents that are not scary for students. (T7)
Most students are afraid of science lessons first; chemistry is an abstract subject for them. Therefore, the students have difficulty to understand the lessons. (T8)

Due to the diversity of students and classroom conditions, some teachers connect science concepts with everyday life events to be easily accepted and understood by students.

> *Using contextual methods about the application in everyday life, so students learn involuntarily by entering the real world. Learning is a process, how teachers take the initiative to be creative and innovative in learning by continuously understanding the character of students who are not a good student. (T7)*

3.3.2 Motivational support for all students

Students in various means need motivation support in learning. It is also necessary to consider that motivation is not permanent. Teachers can attract students' interest, but the motivation may decrease. Therefore, it is necessary to give motivational support continuously to the students. Moreover, motivation is highly individual; what motivates one student is not necessarily interesting for others. Some teachers argued that fostering student's motivation becomes a challenge in science learning.

> *How to grow students' motivation to learn, especially in science subjects become our challenge. (T8)*
> *The challenge is less support, from students' parents to support their child in learning at home. (T6)*

3.3.3 Time constraints

Some teachers claimed that they face difficulties to increase students' performance in science learning because of time constraints. Besides that, according to the teachers, students with low average ability in class will take much time of teacher to explain science materials, whereas teachers need to explain the materials to other students. The challenge is related to the time constraints faced by teachers in teaching science for diverse students.

> *Somewhat it was difficult if the diversity exists in negative term 'low ability' of students in learning activities. Therefore, they need to be given special or extra material that suits their ability at a limited time. (T1)*
> *The challenge is in the students who have abilities under the class average. […] Then to complete science materials, it takes much time, the time is not enough. (T8)*

3.3.4 Mobile devices usage

Teachers in teaching science lesson for diverse students faced the challenge connecting mobile devices.

> *[…] Eventually a lot of time consumed in playing the game and using social media that can harm the students itself when using a mobile phone. (T6)*
> *Although we know the benefits of smart phone that can be used to seek knowledge and information. However, the reality is different, students rarely or even never use for that. They prefer to use for social media only. (T3)*

Teachers tried to use mobile devices as a learning media in the science lesson.

> *However, the student may use his/her mobile phone to browse science contents as well rather than furtive using the mobile phone in my classroom. (T6)*

3.3.5 Teachers' needs for professional development

Based on the participants in this study, a science teacher should support by professional development in teaching science for diverse students, but there is still limited in professional development for the science teacher to prepare them in giving appropriate teaching for diverse students. Concerning inclusive education, teachers admitted that they have never received training to provide appropriate learning to diverse students. The current training is limited to the learning methods for students in general, and it is broadly not only for science but also for all subjects taught in the schools. In addition, while in college or university level, prospective teachers just received a few courses relating to the practice of learning diverse students, including students with SEN. Since, initially the science educator candidate is intended to teach students without SEN, whereas the reality in the school will be different; the teacher meets diverse students in science learning.

> *I have never received such training. Therefore, I do not fully know what inclusion means. (T3)*
> *It seems that no public school receives inclusive training. Including in college, there is no material related to students with special needs or inclusive. All students are considered normal. The additional material in the college becomes important*

because over time many special needs children are encountered. In elementary and junior high school level, I have met on public buses too. (T1)

3.3.6 Availability of adaptive science learning media

The students with SEN require adaptation in the learning material to suit to their current ability level and achieve mastery in learning. Lack of adaptive science learning materials according to the needs of blind student become the next challenge for teachers who have experience in teaching a blind student in her science classroom.

Learning facilities for general students is enough, but for students with SEN is not available yet in our school. Therefore, I use any strategy for traditional learning because there are no special learning facilities for students with special needs. (T9)

Limited educational facilities in the school for students with special needs require teachers to be more creative in providing appropriate learning for the blind student; teachers can use adaptive learning media that available in school. A blind student cannot obtain information visually, so the teacher should be able to use oral communication to deliver science contents that have to be readily understood using simple media that the students have encountered before in the life.

4. Discussions

4.1 Secondary school science teachers' conceptualization the terminology "inclusive education" in general education classrooms

The Indonesia Regulation on National Education System of 2007, No.16, concerning standards of academic qualifications and teachers' competencies noted that science teachers, as specific subject teachers at secondary level, should have pedagogic competency. Teachers must be able to understand students' physical, intellectual, social-emotional, moral, spiritual, and socio-cultural characteristics. Moreover, teachers should have competences in identifying students' abilities and difficulties in learning so that they can use appropriate methods to provide effective learning for diverse students.

Based on nine science teachers' answers, the answers showed that teachers have different prior knowledge toward the meaning of "inclusive education". The responses can be divided into two groups. Three out of nine teachers have limited knowledge toward the term "inclusive." They refer to inclusive education as special education for disabilities students.

The inclusive school is a special school, for people who are special or for those who have disabilities. (T3)

The other six teachers had prior knowledge of inclusive education for all students, but the majority of those teachers tended to focus on students with physical or other disabilities so as to educate them together and treat them equally in regular schools.

Inclusive school is a regular school; it also accepts and educates children with special needs. So, the school is supposed to be a regular school for normal children, but among them there are also some children with special needs. (T9)
Inclusive education means education that is open to all, [it is] non-exclusive education so that all students are treated equally. (T2)

The term "inclusive education" has different definitions in society and varies according to the teachers' situations. The studies of Booth, Ainscow, and Kingston (2006) and Mitchell (2005) showed that inclusive education is a tricky and an abstract idea that lacks a common understanding. Although inclusive education in Indonesia originally was derived from special education, the meaning is now wide. According to the Regulation of the National MOEC of the Republic of Indonesia No. 70 of 2009, inclusive education is intended for all learners, not only for those who have limitations as students in special schools but also students who faced barriers to learning and participate together with normal students in regular schools and those who have special potential intelligence and/or special talents. Moreover, according to Alfian (2013), the concept of inclusive education is the antithesis of the special and exclusive, or segregated education that commonly separates special children from other children. Other scholars found that "inclusive" means regular education that accepted students with special needs (De Boer, Pijl, & Minnaert, 2011; Garuba, 2003; Leatherman & Niemeyer, 2005; Mastropieri & Scruggs, 2004; Rousso, 2003). Moreover, the National MOEC of the Republic of Indonesia supports the finding that inclusive education is open education, where all children, including students with SEN who wish to go to school can continue to inclusive education in regular schools (Wahyudi & Kristiawati, 2016).

In the current study, the definition of inclusive education based on secondary school science teachers indicated that all teachers do not share an understanding of the meaning of inclusive, although more than half of the teachers, who participated in

interviews, could explain the term according to their prior knowledge and understanding. The science teachers explained inclusive education as an education for all including students with SEN who should be educated in a regular classroom. However, most of these teachers still considered students with SEN only as students with physical disabilities. Teachers who have prior knowledge that inclusive refers to special education also focuses on the students' disabilities. However, the studies of Forlin (2010) and Hodkinson (2005) revealed that the recent focus on inclusion addressed the support of diverse students, and was not limited to those with disabilities but included those who were potentially disadvantages in any circumstance. In contrast to the findings above, the majority of science teachers in this study conceptualized inclusion only in terms of physical disability, rather than from a position of promoting education for diversity.

4.2. Secondary school science teachers' responses to teaching students who faced barriers to learning and participating in science classes

This theme related to social competency in Indonesia Regulation on National Education System No.16 of 2007:

> *Subject teachers must be inclusive, objective and non-discriminatory toward differences in gender, religion, race, physical condition, family background, and socio-economic status of their students.*

Based on teachers' responses, the science teachers still separated types of special needs into two categories of students: those with physical barriers and those with academic barriers. These kinds of barriers influenced teachers' responses to teaching diverse students in general education classrooms. The findings revealed that the participants' responses about their feelings toward students who faced learning and participation barriers in science indicated that the majority did not possess negative feelings toward these students in their science lessons. The secondary school science teachers in this study could accept all kinds of students learning and participating together because they believed that all students had the same right to develop their potential through education. In the case of students with SEN, the teachers still required students to have equal cognitive and intellectual abilities to those who enter regular classrooms in line with the Attachment of Regulation of the National MOEC of the Republic of Indonesia 2006, No.22. This states that:

> *Participants in inclusive education are those students with disabilities without accompanying below average intellectual ability [who] wishes to continue education to a higher education level.*

The results of the interviews indicated that two teachers from different schools were experienced in having taught a blind student, a deaf student, and a student with physical disabilities. Both teachers were female, had a bachelor's degree in education, and had different teaching experiences in handling students with SEN. Both had similar acceptance of the student with physical disabilities, who can receive information from their visual and hearing senses, and the students' physical limitations did not impose negative effect on their ability to acquire information in science lessons. Thus, the teachers did not need to make a significant effort to provide appropriate learning adaptations because the students could take part in the science learning process with other peers. However, the teachers had different responses to blind students who have different cognitive abilities in science classrooms. Teacher with considerable experience in dealing with students with SEN showed better responses to teaching students who faced barriers in science lessons than teacher with minimal experience. However, students' conditions also influenced their opinions.

T9 teacher who showed positive feelings toward teaching diverse students had taught science to a blind student who could master science concepts in the classroom. The student had already acquired various science concepts at the beginning of elementary school through the visual sense. However, the student made considerable effort and had the willingness to study science subject in the regular classroom, so student's condition supported her performance in mastering science materials in the general education classroom. Moreover, T9 had received help from a special needs teacher to handle students with SEN. The studies by Schmidt and Vrhovnik (2015) suggested that teachers need ongoing support from various parties (special needs educators, assistants, volunteers, and parents at home) to meet the diverse needs of students in inclusive classrooms. With the help of experts in special needs, the teacher can cope when having trouble in dealing with SEN students. Moreover, parents' support at home also played a big role for students with SEN in continuing to learn in class. The guidance from special school teachers showed that teachers need the collaboration of various parties so that SEN students can achieve better educational results.

In contrast, T1 who had at some time experience in teaching students with SEN argued that inclusion was not intended for blind students because these students lack access to science lessons visually, but she could accept other students' limitations such as students with physically disabilities or hearing impairments. After confirming with the teacher that the blind student who had attended her science class several times was blind from birth, she noted that the student faced difficulties in accessing science information and had limited prior knowledge related to science concepts. In addition, the teacher did not receive help from special education teachers so that T1 had less knowledge and abilities to encounter the blind student. Some studies make a similar

argument to this teacher, that science teaching depends mostly on visual instructions so that visual limitation makes science lessons difficult for partially sighted learners (Maguvhe, 2015; Sahin & Yorek, 2009).

Apart from these two teachers, the majority of teachers in this study found it possible to cope with teaching diversity in term of teaching students with academic barriers; in addition to the differences in gender, religion, and economic backgrounds among them. They had never encountered students with SEN in term of physical and emotional limitations before, thus they were able to smoothly handle the process of learning science. The main problem faced by most teachers was related to the students' attitudes in learning science; sometimes they were lazy and not enthusiastic about participating. The students with a low willingness needed motivational support and extra time to develop their abilities. Although science lessons (physics, biology, and chemistry) were considered difficult by most students, the teachers had high expectations for their students, including those with SEN. All students had the ability to achieve maximum results by making an effort to reach learning goals with appropriate assistance from the teacher. The students needed high motivation and effort to succeed; thus teachers always had to provide support to the students.

Teachers' responses and feelings are very important in creating an inclusive education system for diverse students in the teaching-learning process. Teachers who believe that all students, including students with SEN, can learn and participate in learning, make students feel confident in engaging in science learning in the classroom. Teachers' positive expectations that all students will participate in the learning process affect how students learn in important ways (Anderman, Sinatra, & Gray, 2012). The findings here indicated that teachers' responses toward teaching diverse students in general education classrooms were related to their previous teaching experience of teaching these students, the severity of the students' conditions, and support from related parties. The majority of teachers in the current study had positive responses about teaching students who faced barriers to learning and participating in science classrooms with cognitive requirements that should be equal to other students.

4.3 Secondary school science teachers' implementation of inclusive science practices in general education classrooms

To build inclusive environment, an inclusive teacher should have the skills to construct a culture of learning for all in the classroom and the whole school surroundings (Booth et al., 2006). In the same way, Jennings and Greenberg (2008) emphasize that teachers should have the competencies to create a friendly classroom climate in which all types of learners can perceive comfortable. Teachers should have abilities of developing shared inclusive values for all school society (Booth & Ainscow, 2002).

In relation to the interviews results, the teachers' answers showed that secondary school science teachers who participated in this study made an effort to create and develop an inclusive culture that reflected science practices, which could educate all students in general education. The secondary school science teachers in this study claimed that they used various methods depending on the type of subject matter and the time available for science learning, such as laboratory practices, demonstrations, outdoor learning, cooperative learning, and problem-based learning. In creating an inclusive atmosphere in science learning, the majority of teachers use group work and peer teaching methods so that all students can participate actively in learning, understanding diversity among the students, and helping each other.

> *By creating study groups. Each group varies in capability. This system is like having a peer tutor. Smart students can explain and share the material with their friends in the group.* (T2, T4, T5, T6, T8, and T9)

Group work and peer teaching methods are beneficial for inclusive learning. The teachers use learning groups in heterogeneous assemblages so that students can learn from others and can foster their motivation and experience about the meaning of diversity in learning. Students can actively develop their abilities through flexibility in-group work. Teachers make choices every day regarding many aspects of science classrooms, such as the grouping arrangements (e.g., heterogeneous versus homogeneous) to invite students' participation (Anderman et al., 2012; Anderman & Anderman, 2010; Anderson, 2003; Klimczak, Balli, & Wedman, 1995). Moreover, the learning process will involve participation not only between teachers and students but also with fellow students and other learning resources (Alfian, 2013; Anderman et al., 2012). Studies by Hidi, Weiss, Berndorff, and Nolen (1998) cited in Anderman et al. (2012) show that students prefer to do group learning so that they can develop their thoughts with peers.

The variety and the existence of a flexible classroom have the opportunity of creating a learning community for diverse students to get support from their peer groups through peer tutoring, which promotes peer acceptance and guidance; the teacher, on other hand, has to focus on enhancing peer tutoring and guidance for effective inclusive learning to occur (Buli-Holmberg & Jeyaprathaban, 2016). To create effective teaching in promoting inclusive science practice must occur between teachers and students as well among students in the class. Development in science teaching can be applied by engaging students to work in small groups to assess each other's work (Kaptan & Timurlenk, 2012). Teachers determined that students with visual impairments generally learned more effectively to work together with sighted peers. This collaborative work helped these students build social relationships with others and become more involved with class activities (Rule, Stefanich, Boody, & Peiffer, 2011; Sahin & Yorek,

2009).

The study also revealed that teachers faced various challenges, such as giving students a positive outlook on science and motivational support. The students felt that science lessons consisted of abstract concepts, and science was a difficult subject to understand. Every science teacher has a responsibility for students' view, because it can influence their work in science classes (Cheung, 2009) to change students' perceptions in this regard. Trna and Trnova (2015) show that students' motivation toward science and technology is an essential and demanding task for teachers.

Time constraints in science learning become are also a challenge faced by teachers because of the difference among students in their level of acceptance of mastering science concepts. Kadbey, Dickson, and McMinn (2015) found that the majority of science teachers perceived time constraints as a barrier to covering the science curriculum. Using mobile devices and the availability of adaptive science learning media were the other challenges faced by science teachers in the current study. Smartphone usage for some students is still limited to entertainment, so that linking learning with the use of smart phones become a challenge in the classroom (Barnwell, 2016). Teachers in this study also faced this challenge. Their ability to use technology, such as mobile devices, is essential to enabling students to master the technology as a means of learning. Meanwhile, very few teachers adopt mobile learning for teaching-learning activities, this shows the readiness of the teacher needs to be improved (Blackwell, Lauricella, & Wartella, 2014).

Adapting teaching materials to students' needs is very important in creating varied and flexible classrooms to improve inclusive science practices for students with SEN. Adaptive learning materials, such as braille books for the blind students, must be provided to meet the needs of students with visual impairment. The adaptive materials also help them to develop the necessary skills required to learn and master the subjects (Buli-Holmberg & Jeyaprathaban, 2016). Teachers' abilities are critical to use technology, such as mobile devices. They can use the mobile devices owned by most students as an adaptive learning media so that appropriate assignments given to the students can minimize the problem of limited learning time.

Teachers in this study tried their best to face the challenges of creating inclusive science learning for diverse students. Some teachers relate science topics to applications in daily life so that science learning will be more meaningful. General science-related education in the contexts of nature, related to everyday life and the living environment. It can facilitate and promote students' interests, thereby enhancing general personality development and educational outcomes (Trna & Trnova, 2015). It is also important to collaborate with special school teachers in teaching students with SEN to learn the best methods and forms of adaptation needed for the students. Adaptations from both general and special needs teachers help students to meet their unique needs so as to attain mastery subjects' contents in learning (Buli-Holmberg & Jeyaprathaban, 2016). This statement suggests that cooperation between regular teachers and special education teachers is important in collaborating to provide appropriate teaching and learning for students with SEN in accord with students' conditions.

In this respect, some teachers use mobile devices as learning media in their science classrooms. Several studies show that mobile learning helps to enhance learners' retention and assists them in completing their courses, by addressing individual learning needs with flexibility, and reaching out to those who were previously unreachable (Cobcroft, Rachel, Towers, Smith, & Bruns, 2006; Fozdar & Kumar, 2007). Mobile learning can be used for various activities that support the learning process of students, ease of access will further optimize learning time in the classroom (Awadhiya & Miglani, 2015). So far in this study, with regard to science learning, mobile learning is still limited to browsing information and science materials on the internet. Therefore, the optimization of mobile phone usage in science learning needs to be expanded so that students can benefit more from the use of such communication tools.

Given the findings from the interviews, this study shows that science teachers can demonstrate their skills and abilities in their efforts to create inclusive science practices for diverse students to face the challenges that exist in science learning. Science teachers in this study argued that in-service training on inclusive education and additional courses for prospective teachers are necessary for providing knowledge for teachers and prospective teachers on inclusion, so that they are prepared for the diversity of students with SEN in general education settings. It would be beneficial to have regular workshops for all science teachers to handle science learning effectively for these students (Parker, Osei-Himah, Asare, & Ackah, 2018). Moreover, Schmidt and Vrhovnik (2015) suggested that it is important to general teacher collaborate with other related parties to provide the best learning for diverse students.

5. Conclusion

From the interviews results, are shown that the majority of secondary school science teachers conceptualized inclusion only in term of disability, rather than from a position of promoting education for diversity. Besides, the science teachers' responses toward teaching students who faced barriers to learning and participation in science classrooms were predominantly positive. But

they were still in doubt to include students with SEN to learn together with other students in science classrooms, depend on the severity of those students' conditions, their previous experiences, and the availability of supportive facilities for SEN students. The science teachers made an effort to support the creation and evolution of an inclusive culture and inclusive science practices for diverse students through group work and peer tutoring approaches. The teachers also can demonstrate their skills and abilities to face the challenges that exist in science learning. The results of this study show that general teachers require training on inclusive education as well as an additional course in teachers' preparation program.

6. Future Direction

The study was based on science teachers' perspectives on inclusion. In future research, direct observations will be necessary to reveal actual teaching competencies of science teachers.

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